Bessel, 1841	690.6″
Clarke, 1866	700.4″
Harkness, 1891	688.2″
Hayford, 1909	695.8″

It appears essential in this connection to call attention to a common misapprehension with respect to the earth which Professors Moulton and Roever have helped to disseminate by their able contributions to the subject before us. The potential function V which appears in equation (1) above, may be developed in a series of spherical harmonics whose first three terms are given in the second member of the following equation:

$$V = \frac{Mk}{r} + \frac{k}{2r^3}\{C - \tfrac{1}{2}(B + A)\}(1 - 3\sin^2\psi) + \frac{3k}{4r^3}(B - A)\cos^2\psi\cos 2\lambda. \quad (4)$$

In this r, ψ, λ are, respectively, the radius vector, geocentric latitude and longitude of the point, outside the earth, to which V applies. M is the mass of the earth, k is the gravitation constant and A, B, C are in order of increasing magnitude the moments of inertia of the earth with respect to a set of principal axes originating at its centroid. C is commonly said to be the moment with respect to the axis of rotation of the earth, but in these days of "variation of latitudes" and of "mathematical rigor," it should be said to apply to the axis of figure nearest the axis of rotation. A and B are then the moments with respect to the principal axes in a plane through the centroid and normal to the axis of C, or in the plane of the equator as we commonly say.

The expression (4) has very remarkable properties. It is equation (26) of my paper cited above. The value of V is the same whether the latitude ψ is positive or negative; and dependence on longitude vanishes if $B = A$. With respect to this equation Professor Moulton remarks "If the rotating body is a figure of revolution about the axis of rotation whose density does not depend upon the longitude, the function V can be developed as a series of zonal harmonics in the form

$$V = \frac{\alpha}{r} + \frac{\beta}{r^3}(1 - 3\sin^2\varphi)."$$

A similar remark with regard to this expression has been quoted above from Professor Roever, the inference being, apparently, that in some manner the expression (4) limits the distribution of the earth's mass to one of revolution. As a matter of fact, however, the expression (4) implies no such restriction; on the contrary, it applies equally to a body of any form and of any distribution of density, the sole requirement being that the point (r, ψ, λ) lie at a distance from the centroid of the body equal to or greater than the greatest distance of any element of mass in the body from the same point. The considerations which permit us to assume $(B - A)$ small, or possibly negligible, in this and other problems of geodesy, must depend, unfortunately, on other sources of information than the expression (4). Some attention to these considerations was given in each of my papers referred to in the first paragraph of this note.

Without going further into the subject at this time it may suffice to remark that it now appears illusory except as a mathematical exercise to push the solution of the differential equations of motion of a falling body to terms involving the second derivatives of V without including the third term in the right-hand member of (4), without taking account of the known relation between these derivatives, and without taking account of plumb-line deflections, which often exceed the discrepancy shown by equations (2) and (3).

R. S. WOODWARD

February 22, 1915

ARTHUR VON AUWERS

THE problems that confront the astronomer differ from those with which workers in other departments of science are engaged in many important particulars, but in none more than in the magnitude of the data involved. So great is the number of the stars, so vast, both in space and in time, the scale of their motions, that in general it transcends the powers of an individual, or even of a single observatory, to collect, within the span of a lifetime, the materials for comprehensive studies, or to collate and discuss them. Cooperation is probably

more essential to progress in astronomy than in any other science.

The earliest example of cooperation on a large scale in astronomical research was the proposition brought forward by Argelander and his associates, half a century ago, for the formation of a great catalogue of all the stars to the 9th magnitude in the northern sky. At the meeting of the Astronomische Gesellschaft in 1869, when, after four years of preliminary discussion, the project was formally initiated, the plan of work adopted was the one presented by Dr. Arthur Auwers, a young astronomer, who, three years earlier, had been elected to membership in the Berlin Academy of Sciences to fill the place left vacant by the death of Encke. In view of Auwer's youth—he was then only 31—this was a notable recognition of his ability. But even more significant was the fact that to him was also entrusted the all-important duty of preparing the system of fundamental star places which provided the foundation for the entire work.

It is impossible, without running unduly into technicalities, to give an adequate idea of the difficulties attending the construction of such a fundamental system of star places. It must suffice to say that it requires the highest order of ability, a profound grasp of the principles of gravitational astronomy, a comprehensive knowledge of star catalogues, rare judgment, and a mastery of detail that is given to but few minds. How well qualified Auwers was for the responsibility placed upon him is evident from the fact that the fundamental system he elaborated more than 40 years ago is adopted, in all its essentials, as the foundation of the greater part of the most refined meridian circle work of the present day.

His connection with the "Astronomische Gesellschaft Catalogue" did not end with the service I have described. In addition, he undertook the observation of one of the sections or "Zones" of the catalogue—producing a model work—and was soon made chairman of the commission in charge of the entire project—a position he held to the date of his death, January 24, 1915. Its success, therefore, is in large measure due to his careful planning and wise guidance. Long before his death he had the satisfaction of seeing the original catalague completed by contributions from no less than twelve great observatories in Europe and America, and of having the plan extended, again under his direction, well into the Southern Hemisphere.

G. F. J. Arthur Auwers was born in Göttingen in 1838 and received his early education in the schools of his native city. His interest in astronomy was manifested when he was still a mere boy, and even before he received his doctor's degree at Königsberg in 1862, he had made many important contributions to it both by observations and by theoretical investigations. His dissertation for the doctorate, on the variable proper motion of Procyon, placed him at once in the front rank of astronomers. In this research he struck the keynote of his future life-work, "the treatment of all questions concerning the positions and motions of the stars."

I shall not attempt even to enumerate his many contributions to this department of astronomy. His services to the A. G. Catalogue have already been mentioned. It must suffice to describe briefly one other research, in many respects his most important—the new reduction of the Bradley stars.

The fundamental data upon which all studies of the mechanics of the stellar universe depend are the positions of the stars on the celestial sphere, their apparent motions on this sphere (technically, their "proper motions"), their radial velocities and their distances. The first two of these elements are derived from the star catalogues based on meridian observations. One of the most important of all star catalogues is that based upon the observations of Bradley, at Greenwich, about the middle of the eighteenth century, for these observations were the first that are at all comparable in system and in accuracy with those of modern times, and they were also superior to those of his successors for fully half a century. As the time element is of the first consequence in the derivation of stellar proper motions, Bessel, who in 1819 made the first reduction of the Bradley observations, was fully justified in giving his work the title "Fundamenta Astronomiæ." Excellent as Bessel's work was,

the rapid progress of astronomy in the next half-century led to a more accurate knowledge of the fundamental astronomical constants and to more refined methods in the reduction of meridian observations, and it also became evident that some of his assumptions respecting Bradley's instrument were erroneous. A new reduction was therefore highly desirable and this was undertaken by Dr. Auwers in 1866. He brought all his skill and special knowledge into play and spared no pains to insure the utmost accuracy in his work. The result of the ten years' labor it involved has been well called a "masterpiece and a model." The Auwers-Bradley catalogue at once became the starting point for all discussions of proper motions—a position it will probably hold for all time.

His fundamental system of star places, the Auwers-Bradley catalogue, and his other work in related fields, will form Auwer's most enduring monuments, but they are far from comprising the full measure of his activities. Thus, he was chairman of the German Commission for the determination of the solar parallax from the transits of Venus in 1874 and in 1882. He took the leading part in preparing the observing programs, conducted in each year one of the expeditions sent out by the government, and personally directed the elaborate discussion of all the results—a truly monumental work which fills six large quarto volumes.

From 1878 to 1912 Auwers held the position of Secretary of the Section for Mathematics and Physics in the Royal Prussian Academy of Sciences (Berlin Academy) and his tactful conduct of the manifold duties of this office, together with his unselfish and tireless devotion to the interests of the academy were gratefully acknowledged by his colleagues at the meeting of June 25, 1912, when they celebrated his jubilee—the fiftieth anniversary of his graduation as doctor of philosophy.

He founded the bureau of the "History of the Sidereal Heavens" (Geschichte des Fixsternhimmels) whose object it is to collect all of the meridian observations of stars since Bradley's time and to combine them into a single systematic catalogue. He was a member of the commission charged with the organization of the Astrophysical Observatory at Potsdam, and assisted in the supervision of its construction and of its management in its early years. He was also the first president of the International Association of Academies.

Auwers's commanding position in his chosen science was fully recognized in his own country and throughout the world. His own government gave him the title Wirklicher Geheimer Ober-Regierungsrat, and at the time of his death he was Kanzler des Ordens pour le mérite für Wissenschaft und Künste. For more than twenty years before his death he had been a member of the seven leading National Academies of Science in Europe and America, a distinction in which but two other astronomers of his generation shared—Newcomb and Schiaparelli. In 1888, he was awarded the gold medal of the Royal Astronomical Society of London, in 1891, the Watson gold medal of our National Academy, and in 1899, the Bruce gold medal of the Astronomical Society of the Pacific. His death marks the passing of one of whom Newcomb wrote, nearly twenty years ago, "To-day, Auwers stands at the head of German astronomy. In him is seen the highest type of the scientific investigator of our time." These sentences well express the judgment of all astronomers at the present day.

R. G. AITKEN

March 22, 1915

SCIENTIFIC NOTES AND NEWS

A MEETING to commemorate the life and scientific work of the late Charles Sedgwick Minot was held on March 17, in the hall of the Boston Society of Natural History. As president of the society since 1897, Dr. Minot had taken great interest in its welfare and growth, and it was due in large part to his efforts that the society has undertaken the study and exhibition of the natural history of New England as its special field. At the meeting addresses were made by Dr. Henry H. Donaldson, of the Wistar Institute of Anatomy and Biology, and Dr. Charles W. Eliot, of Cambridge. Dr. Donaldson especially dwelt upon Minot's early interest in natural history and his scientific career. Dr.